

Cosmic Acceleration and Fundamental Physics

Andreas Albrecht (UC Davis)

Presented at the SNAP DOE review

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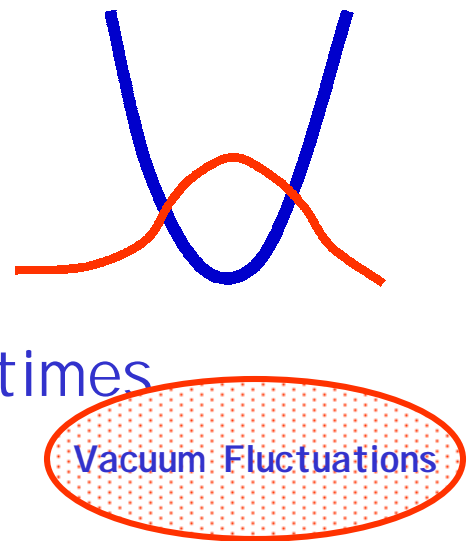
Outline

- 1) The accelerating Universe
- 2) The Impact of a SNAP-class dataset

1) The accelerating Universe

➤ Deep implications for fundamental physics:

- The cosmological constant problem (why is Λ not 10^{120} times larger?)



- Dream: Magical symmetry sets $\Lambda \equiv 0$

- Fundamental nature of matter (string/M etc.)



Entropy (i.e. Banks)

Structure of String/M

(22)
IF IT IS THE CASE THAT

IN STRING THEORY, ^{TOGETHER} $\Lambda > 0$ BUT

~~THE~~ EXTREMELY SMALL IS IMPOSSIBLE,

I FOR ONE WON'T BE TOO UPSET

BECAUSE I FIND SUCH A UNIVERSE

UNPLEASANT TO CONTEMPLATE.

ASSUMING RECENT EXPERIMENTAL

FINDINGS HOLD UP, I'D HOPE FOR

A DIFFERENT INTERPRETATION OF THEM

THERE MIGHT BE SOME MORE

RADICAL POSSIBILITIES, BUT TWO

CONSERVATIVE OPTIONS COME TO

MIND AT ONCE:



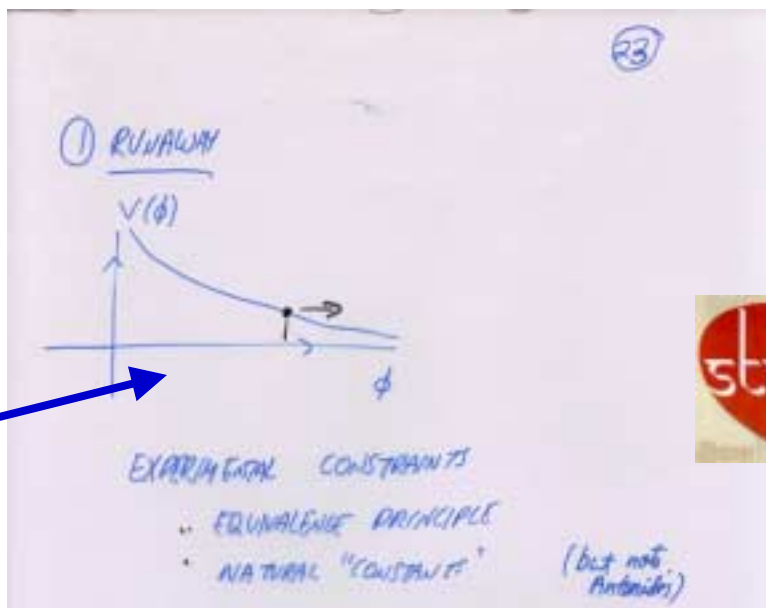
Ed Witten: Quantum gravity in deSitter space



➤ Current status: Quintessence/Dark energy ideas give a rich phenomenological landscape:

- Different versions of cosmological evolution/a variety of observable signatures.
- Growing links with fundamental physics.

➔ Great prospects for progress



Ed Witten,



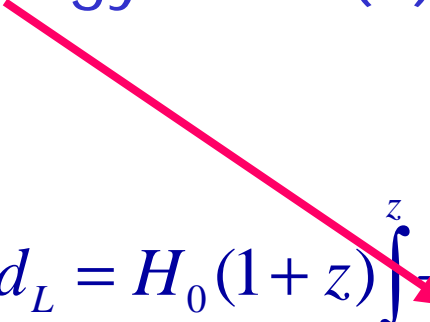
(Restore $\Lambda=0$ dream?)

2) The Impact of a SNAP-class dataset

Basic points:

- Measure cosmology via $m(z)$

$$m(z) = M + 5 \log D_L$$

$$D_L = H_0 d_L = H_0 (1+z) \int_0^z \frac{c}{H(z')} dz'$$


- Huge space of models →
Parameterize dark energy. We use

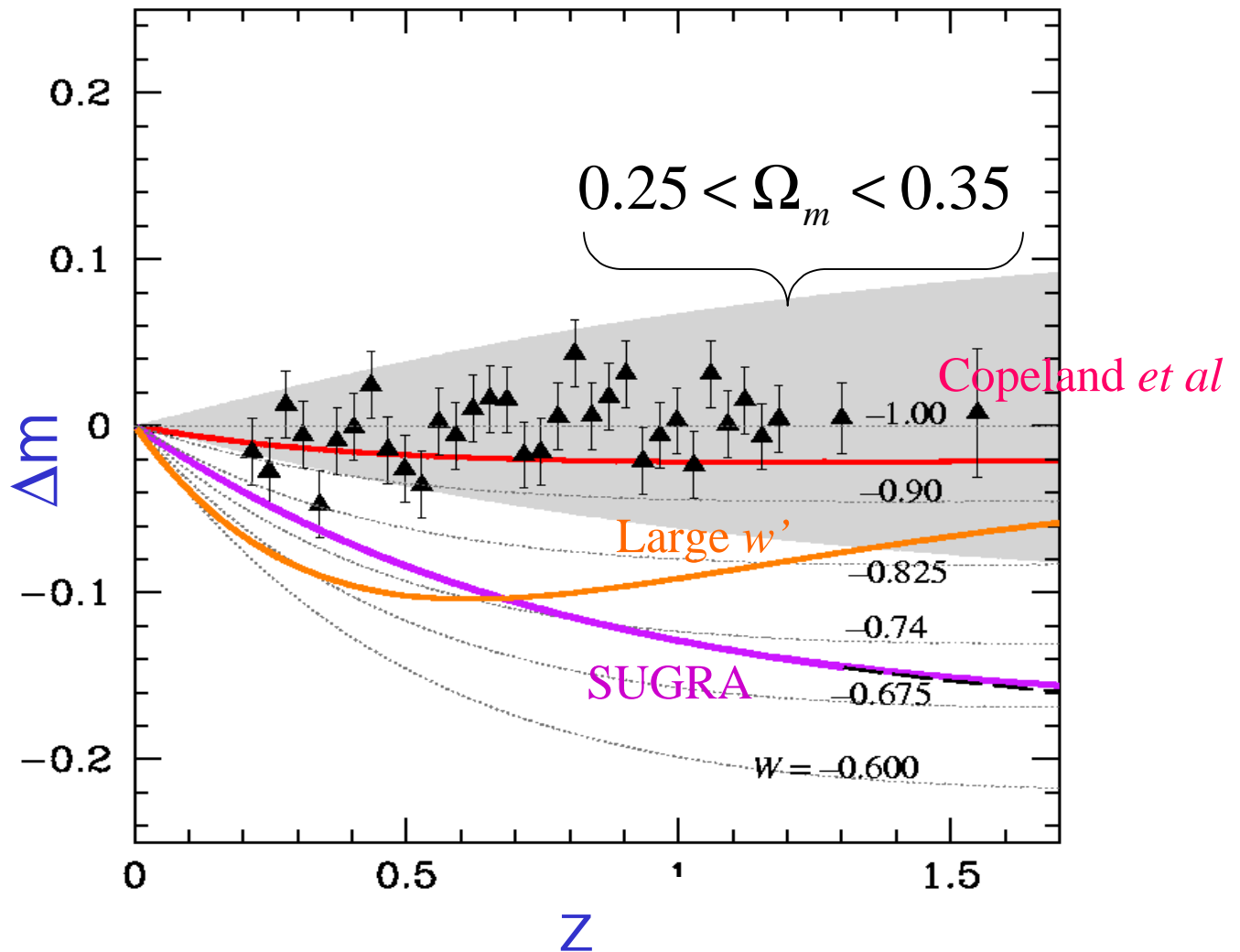
$$p_Q = w \rho_Q$$

$$w(z) = w_0 + w' z + \dots$$

Gives good physical intuition + best fit to existing models.

AA & Weler, Huterer and Turner, Maor et al

Magnitude residuals (vs a $\Lambda=0.7$ model)
for simulated SNAP data and theoretical
models



$$p_Q = w\rho_Q$$

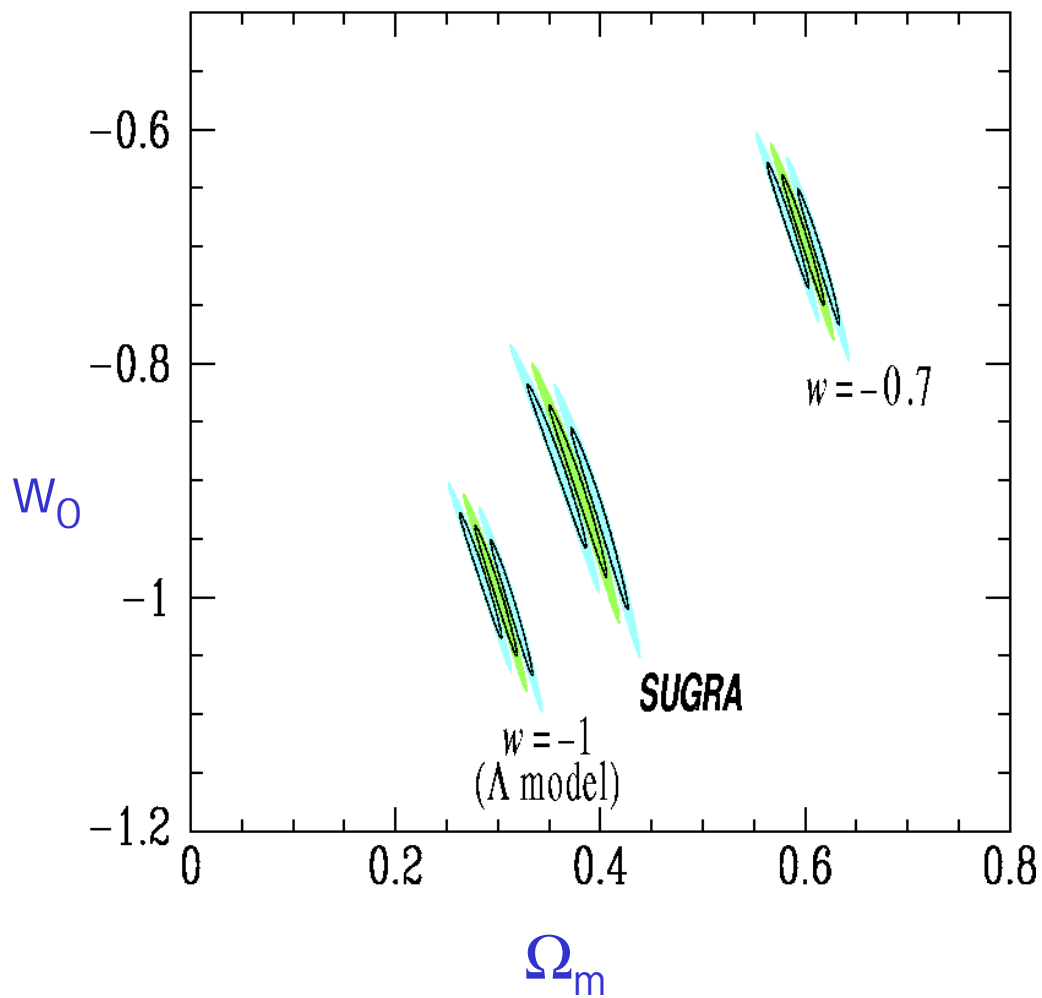
$$w = -1 \Rightarrow \Lambda$$

deSitter space

$$w(z) = w_0 + w'z$$

Large w' : $= (-0.6) + (-0.8)z$

Weller & AA (2000)

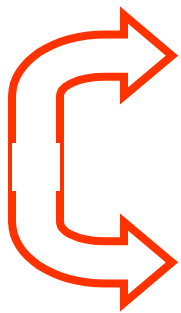


Snap uncertainties in w_0 - Ω_m space

Weller & AA (2000)

Conclusions

- Cosmic acceleration: The most exciting subject in all of physics(!):



- Deep implications (*physics*)
- Opportunities for real progress (*astronomy*)

- Impact of new data driven by **fundamental physics**.
Not just a few new parameters to fit.